

CLAIMS

1. An electrolytic solution for use in an electrolytic capacitor, comprising a solvent and a solute, wherein water accounts for 20 to 100% by weight of the solvent and the total solute content is from 1.5 to 44% by weight.

2. The electrolytic solution for use in an electrolytic capacitor according to claim 1, which comprises at least one solute selected from a carboxylic acid or a salt thereof and an inorganic acid or a salt thereof, and further comprises one or more compounds selected from a nitro compound, a nitroso compound or a salt thereof, a chelete forming compound or a salt thereof, saccharides, a phosphoric acid compound or a derivative thereof, a water-soluble polymer and a silane coupling agent alone or in combination.

3. The electrolytic solution for use in an electrolytic capacitor according to claim 1 or 2, wherein the content of water is from more than 75% by weight to 100% by weight based on the solvent.

4. The electrolytic solution for use in an electrolytic capacitor according to claim 1 or 2, wherein the content of water is from more than 80% by weight to 100% by weight based on the solvent.

5. The electrolytic solution for use in an electrolytic capacitor according to claim 1 or 2, wherein the content of water is from more than 90% by weight to 100% by weight based on the solvent.

6. The electrolytic solution for use in an electrolytic capacitor according to any one of claims 1 to 5, wherein the electrolytic solution has a specific resistance at 30°C of 65  $\Omega \cdot \text{cm}$  or less.

7. The electrolytic solution for use in an electrolytic capacitor according to any one of claims 1 to 6, wherein the solvent comprises water and at least one organic solvent and the organic solvent is selected from the group of protonic organic solvents consisting of

monohydric alcohols including methyl alcohol, ethyl alcohol, propyl alcohol and butyl alcohol, dihydric alcohols including ethylene glycol, diethylene glycol and triethylene glycol, and trihydric alcohols including glycerin, and the group of aprotic solvents consisting of  $\gamma$ -butyrolactone, propylene carbonate and sulfolane.

8. The electrolytic solution for use in an electrolytic capacitor according to any one of claims 1 to 7, wherein the total solute content is from 23.5 to 44% by weight.

9. The electrolytic solution for use in an electrolytic capacitor according to any one of claims 1 to 7, wherein the total solute content is from 1.5 to 5% by weight.

10. The electrolytic solution for use in an electrolytic capacitor according to any one of claims 2 to 9, wherein the carboxylic acid or salt thereof is selected from the group consisting of formic acid, acetic acid, propionic acid, butyric acid, salicylic acid, borodisalicylic acid, nitrobenzoic acid, dinitrobenzoic acid, hydroxybenzoic acid, oxalic acid, malonic acid, succinic acid, glutaric acid, adipic acid, fumaric acid, maleic acid, phthalic acid, azelaic acid, sebacic acid, citric acid and hydroxybutyric acid, and ammonium, sodium, potassium, amine and alkylammonium salts thereof, and is contained in the amount of 0.5 to 44% by weight based on the total amount of the electrolytic solution.

11. The electrolytic solution for use in an electrolytic capacitor according to any one of claims 2 to 10, wherein the inorganic acid or salt thereof is selected from the group consisting of carbonic acid, hypophosphorous acid, phosphorous acid, phosphoric acid, boric acid and sulfamic acid, and ammonium, sodium, potassium, amine and alkylammonium salts thereof, and is contained in the amount of 1 to 20% by weight based on the total amount of the electrolytic solution.

12. The electrolytic solution for use in an

electrolytic capacitor according to any one of claims 2 to 9, wherein the water-soluble polymer is a synthetic or natural polymer having a molecular weight of 100 to 2,000,000.

5           13. The electrolytic solution for use in an electrolytic capacitor according to claim 10, wherein the synthetic polymer is selected from the group consisting of polyacrylic acid, polymethacrylic acid, polyacrylamidepolyvinyl alcohol and polyethylene oxide, 10           and a salt, an ester or a derivative thereof, and the natural polymer is polyalginic acid or poly  $\gamma$ -glutamic acid.

          14. The electrolytic solution for use in an electrolytic capacitor according to any one of claims 2 15           to 13, wherein the nitro compound is selected from the group consisting of nitrophenol, dinitrophenol, nitrobenzoic acid, dinitrobenzoic acid, trinitrobenzoic acid, nitroanisole, nitroacetophenone, aminonitrobenzoic acid, nitrosalicylic acid and nitroguanidine, and a salt 20           or derivative thereof, and the nitroso compound is selected from the group consisting of nitrosobenzoic acid, nitrosonaphthol, nitrosophenol and copperon, and a salt or derivative thereof.

          15. The electrolytic solution for use in an electrolytic capacitor according to claim 14, wherein the 25           nitro compound and/or the nitroso compound is/are contained in the amount of 0.05 to 10% by weight based on the total amount of the electrolytic solution.

          16. The electrolytic solution for use in an electrolytic capacitor according to any one of claims 2 30           to 15, wherein the chelete forming compound is selected from the group consisting of ethylenediaminetetraacetic acid, trans-1,2-diaminocyclohexane-N,N,N',N'-tetraacetic acid monohydrate, dihydroxyethylglycine, 35           ethylenediaminetetrakis(methylenesulfonic acid), diethylenetriamine-N,N,N',N"-N"-pentaacetic acid, citric acid, diaminopropanoltetraacetic acid,

ethylenediaminediacetic acid, ethylenediamine-N,N'-bis(methylenesulfonic acid) 1/2 hydrate, glycol ether diaminetetraacetic acid and hydroxyethylethylenediaminetriacetic acid.

5           17. The electrolytic solution for use in an electrolytic capacitor according to claim 16, wherein the chelete forming compound is contained in the amount of 0.01 to 5% by weight based on the total amount of the electrolytic solution.

10           18. The electrolytic solution for use in an electrolytic capacitor according to any one of claims 2 to 17, wherein the saccharides are selected from the group consisting of monosaccharides, disaccharides, trisaccharides, polysaccharides, and a derivative thereof.

15           19. The electrolytic solution for use in an electrolytic capacitor according to claim 18, wherein the saccharides are contained in the amount of 0.01 to 10% by weight based on the total amount of the electrolytic solution.

20           20. An electrolytic capacitor comprising a capacitor element, a case containing the capacitor element, and a sealant with which the case is sealed, the capacitor element comprising a pair of electrode foils each comprising a dielectric, a separator for isolating the electrode foils from each other, and an electrolytic solution filled between the electrode foils, wherein the electrolytic solution is the electrolytic solution for use in an electrolytic capacitor according to any one of claims 1 to 19.

25           21. The electrolytic capacitor according to claim 20, wherein the separator of the capacitor has a space in which ions are capable of migrating between the electrode foils even under low temperature conditions, and has a density of 0.5 or less.

30           22. The electrolytic capacitor according to claim 20 or 21, wherein the separator comprises fibers fixed

with a binder soluble in the electrolytic solution.

23. The electrolytic capacitor according to any one of claims 20 to 22, wherein the case is made of a non-heat-treated aluminum having purity of 99.0% or higher.

5        24. The electrolytic capacitor according to any one of claims 20 to 22, wherein the case is made of an aluminum alloy containing manganese and/or magnesium.

10       25. The electrolytic capacitor according to any one of claims 20 to 24, wherein the sealant comprises a resin-vulcanized isoprene-isobutylene rubber or a peroxide-vulcanized isobutylene-isoprene rubber.

26. The electrolytic capacitor according to any one of claims 20 to 25, further comprising external terminals of a copper or silver wire.

15       27. The electrolytic capacitor according to any one of claims 20 to 26, which is used at a temperature of - 40°C or higher.

20       28. The electrolytic capacitor according to any one of claims 20 to 26, which is used at a temperature of - 25°C or higher.